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FIG. 1.

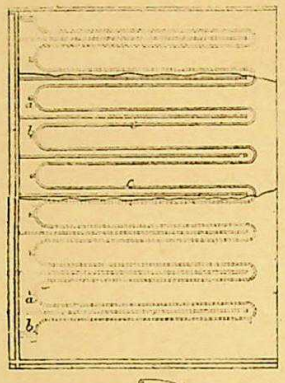


FIG. 2.

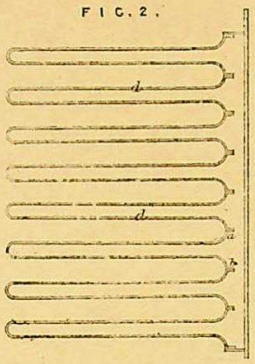


FIG. 3.

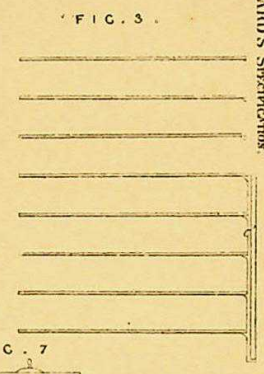


FIG. 7

FIG. 4.

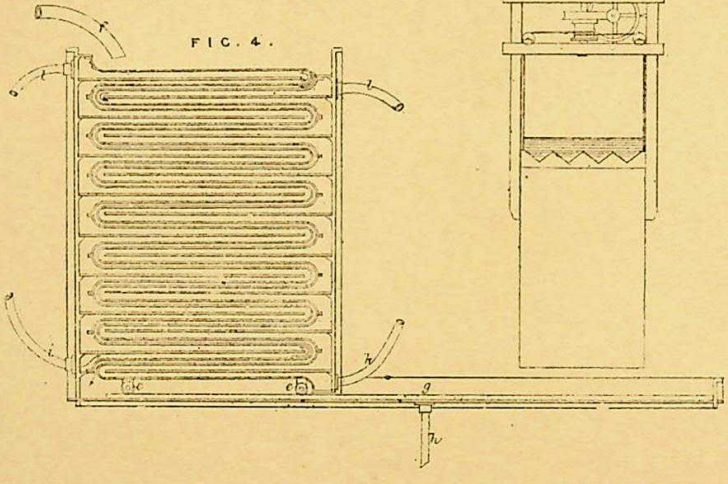


FIG. 5.

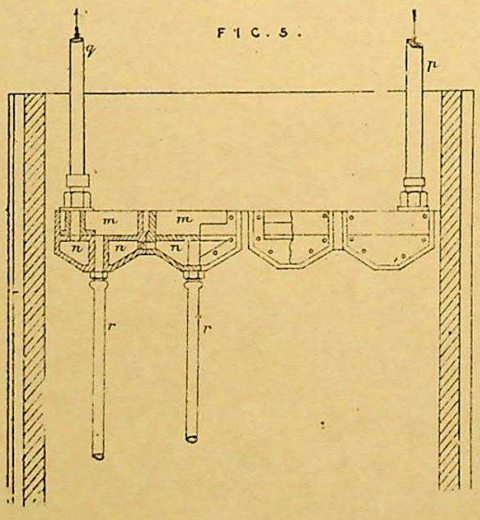
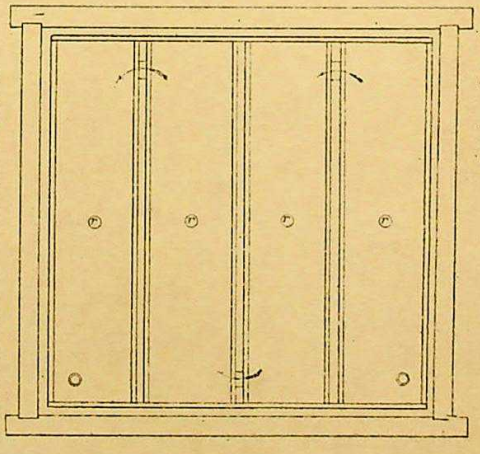


FIG. 6.



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A.D. 1862, 29th April. N° 1256.

Heating, Cooling, and Condensing Apparatus.

LETTERS PATENT to William Littell Tizard, of Mark Lane, in the City of London, Engineer, for the Invention of "Improvements in Heating, Cooling, and Condensing Apparatuses."

Sealed the 24th October 1862, and dated the 29th April 1862.

PROVISIONAL SPECIFICATION left by the said William Littell Tizard at the Office of the Commissioners of Patents with his Petition on the 29th April 1862.

I, William Littell Tizard, of Mark Lane, in the City of London, Engineer, do hereby declare the nature of the said Invention for "Improvements in Heating, Cooling, and Condensing Apparatuses," to be as follows:—

My Invention consists in casting of any suitable metal, or compound of metals in one piece a square or oblong cellular plate, closed on three sides, and open on its fourth side. Two of its contiguous sides have flanges on both top and bottom, which project a little more than one half of the thickness of its two other sides, which are without flanges. The interior of this cellular plate is provided partitions parallel with each other, each of which is short at one end alternately, so as to prolong the current of such fluids as pass between them and around their short ends. These partitions by being cast on the top and bottom portions of the cellular plate also strengthen the casting, and enable it to withstand considerable internal pressure. A number of these

castings of adequate area, and proportionate to the power of the instrument required being provided, the flanges of each are planed and bolt holes drilled in them to correspond each with the other. These cellular plates are now piled one on the other, coming in contact by their flanges, only sufficient space being allowed between their thinner parts to admit the flat and thinnest part of a plate (being its flangeless parts) without either touching the other. This pile or nest of plates is bolted together on two sides. The edges of the open side of the nest (all the open sides being one over the other) are now planed to admit of being closed water or steam-tight by a door. There are also communications from one cellular plate to another, and ingress and egress pipes, by which steam, water, or other fluid passes from one corner of the lowest plate to one corner of the uppermost plate, traversing in its devious course around one end of each partition, and upwards by means of a short tubular connection into the next plate, and through its somewhat zig-zag course, heating or cooling the two surfaces of each cellular plate throughout the whole series of the nest until the fluid makes its exit. The above being but one-half of the apparatus, a similar nest of cellular plates is constructed, excepting that it is mounted on four grooved wheels, and its upper plate has its sides raised, so as to form a shallow receptacle for the fluid to be cooled or heated. One of these nests is fixed in a shallow trough, on the bottom of which is a small tramway. The four grooved wheels before alluded to are placed on the lowest part of the other nest, which runs on the tramway where it approaches or recedes from its counterpart, videlicit, the stationary nest first described. When these two nests of circular plates are brought together, they intersect without touching each other either top or bottom, thus forming a shallow space or channel throughout their combined series of one-sixteenth of an inch or less in depth between each plate, but their sides necessarily touch to prevent the fluid that is being operated on running in a wrong direction.

When the apparatus above described is used for heating water, the two nests are run into each other, or rather the movable nest is run into the stationary one, and the water flows over the top plate, passing over its front edge, and falls on the innermost surface of the second plate (which is the uppermost in the fixed chest), and under the bottom of the top plate, until it reaches the front of the second plate, when the water flows back (but still descending) between the bottom of the second plate and the surface of the third plate, and so on until it reaches the trough, from which it is conveyed to its destination. During the time the water is flowing through this thin channel steam passes into the lowest cellular plates of both nests by

separate pipes, winding its way through the passages formed by the internal partitions, and upwards through each plate until it makes its exit from a pipe in the top plate of each nest. By regulating the quantity of either steam or water, the latter is heated to any temperature required while running through the apparatus.

When the above instrument is used for the purpose of cooling liquids, such as brewers' worts, for example, the hot wort is run on to the top plate and through the thin channel formed by the exterior of the combined nests of cellular plates; cold water flows upwards through their interior in the same devious path which the steam takes when heating a fluid. Any instrument which is used for the above purposes requires cleaning daily, or immediately after using. To cleanse the exterior parts of this apparatus ample space is afforded by merely separating the two nests by rolling the one on the tramway out of its fixed counterpart. Their separation at once converts the channels that were before but from a sixteenth to a tenth of an inch deep into open spaces or gaps of about $1\frac{1}{2}$ inch or two inches in depth, each of which is open sufficiently on two sides to admit an ordinary scrubbing brush. The interior steam or cold water spaces are cleaned with equal facility on opening the doors which close them when in use. The novel character of this arrangement of cellular plates consists in making the apparatus in two similar and separable parts, so that when they are asunder they may be readily cleaned, and when together a channel of a limited thinness is formed for the passage of the fluids to be either heated or cooled.

In constructing steam condensers for marine and other purposes (such as distilling) upon the principle above described, the cellular plates have but one flange on each side instead of two, as before described, and are placed on their edges (upright) and side by side to facilitate their drainage or exhaustion, and are an inch or more apart when the two nests are together, so as to make room for a large quantity of condensing water. When the two nests are separated for the purpose of cleansing them, they present spaces at least three inches deep, (or wide, the plates being vertical,) being ample for the introduction of scrapers or scrubbers of any strength or form, the steam condenses on the interior of each cellular plate. When preferred the condensing water may be made to flow through the plates, and the steam to condense on their outsides. By this reversal the power of the condenser is greater, and a more perfect vacuum ensured, owing to the very thin steam spaces which are afforded by this arrangement. The apparatus is enclosed in a suitable case, and supplied with the necessary ingress and egress pipes.

Another part of my Invention has for its object economy of heat and fuel

on board such steam ships as are not provided with surface condensers, and where the common jet system of condensation only is in use. Sea water contains a variable quantity of common salt, besides a small quantity of salts of lime and magnesia. To allow these substances, particularly the two last, to accumulate in the boilers, is to hasten their destruction by the formation of a hard insoluble scale which obstructs the free passage of heat from the furnaces to the water. The thickness of the deposit is proportionate to the temperature of the water, the quantity of salts it holds in solution, and the frequency of blowing off. To prevent their accumulation and adhesion to a dangerous extent a much larger quantity of water is pumped into the boilers from the hot well than is required for the formation of steam, and this additional water is blown out again into the sea with its surplus salts and acquired caloric. This process of feeding and blowing to be effective is continuous, and amounts upon an average to one-half of the water fed into the boilers during a voyage. The heat thus blown away is generally equivalent to 20 per cent. of the coals consumed, and in water of southern latitudes is considerably greater, notwithstanding that all the water used comes from the hot well at a temperature varying from 100° to 120° Fahrenheit. The temperature of the water thus blown away depends upon the pressure of the steam under which the engines are worked, which, if taken at 20ths per inch would be 261°. The foregoing conveys the necessary data, videlicit, that as much water at 261° is blown out of the boilers as is supplied to them at 110°.

This part of my Invention is to cause the well water and the blown out water to exchange their temperatures. I pass the waste water as it is ejected from the boilers through a cellular or tubular apparatus, (which is here called a refrigerator,) on one side of its plates or tubes (as the case may be) into the sea, and at the same time by pumping the well water in the opposite direction through the same apparatus on the other side of the plates or tubes into the boilers, thus the well water enters the apparatus at 110°, and goes into the boilers at 261°, while the waste water is cooled from 261 to 110° before it escapes to the sea.

The following arrangement not only utilises a great portion of the heat heretofore lost by a wasteful system, but in addition thereto increases the purity of the water supplied to the boilers, and proportionally reduces the necessity of blowing off. The before-named refrigerator is mounted with a steam chest, connected with the hot well by means of a pipe and cock. On partially blowing off the briny contents of a boiler, instead of conveying them directly through the refrigerator as at first proposed, they are detained there a minute or two, or until the pressure in both boiler and refrigerator is the

same when the latter is nearly full. About half a minute more is sufficient to allow the steam and water to separate and settle. The cock in the steam chest is now turned on and the steam converted by condensation into fresh water by mixing with the contents of the hot well. Thus the purity of the feed water is increased, as is also its temperature. The contents of the refrigerator are by this evaporating process reduced from 261° to 212° Fahrenheit. The well water is now pumped through the apparatus, and in its transit to the boilers is heated to 212°. The waste or blow off water is blown into the sea by the next charge a few degrees hotter than that from which no steam was taken, in consequence of the feed water acquiring additional heat from the extra steam it condenses.

Another arrangement, form, and adaptation of cast cellular plates is designed for cooling the surface of brewers' worts when they are undergoing the vinous fermentation, and also for collecting the yeast therefrom, so as to supersede the ordinary mode of cleansing into a number of small casks. It consists in casting them of any suitable metal, such as copper, brass, or iron, and afterwards tinning or galvanizing them. They are of an oblong form, with shallow trough-like tops, inverted cone-like bottoms, and closed ends, with one or more partitions running through their interior. Three or more are bolted together side by side about an inch apart; it is through the spaces thus formed that the yeasty wort rises, and they are connected by means of tubes for the ingress and egress of water which runs through the series. The raised sides by which their trough-like surfaces are formed are also connected by short pipes, through which the yeasty contents of one trough flow into the other.

Improved means to regulate the cooling and separation of such clean beer as subsides on and under precipitated and floating yeast, is also an additional improvement. The apparatus consists of a tube screwed on its exterior, which passes through one of the double troughs working in a screwed nut and a stuffing box. On the upper end is a small cup or cistern, with a few holes in its bottom, and a movable cover on its top. It is through the perforated bottom that all the beer passes that runs from the surface of the double troughs (or the series of barm backs) downwards into the square. By raising or lowering this separating apparatus so that its perforations shall be in the clean beer towards the close of the fermenting or cleansing process, the latter will flow away cool into the fermenting tun leaving all yeast behind on the troughs or barm backs.

When this cellular cooling, fermenting, and cleansing apparatus is applied to brewers' "squares" (rounds or ovals may also be fitted with apparatus con-

structed as herein-before described, but with such modifications as the shape of the vessel demands) a pillar is fastened on each corner of the square, supporting a frame which carries a wire-rope pulley on each corner, and its centre supports a vertical drum, and its actuating worm and wheel. A wire rope is attached to each corner of the united troughs, (which constitute the cooling, fermenting, and cleansing apparatus,) passes upwards and over each pulley, and each rope runs horizontally to the vertical drum to which it is fastened. These ropes are coiled round the drum by turning the winch on the worm shaft when the apparatus is raised, by reversing its motion the apparatus is lowered. This arrangement of gearing keeps the troughs level and stationary in all situations.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said William Littell Tizard, in the Great Seal Patent Office on the 29th October 1862.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, William Littell Tizard, of Mark Lane, in the City of London, Engineer, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-ninth day of April, in the year of our Lord One thousand eight hundred and sixty-two, in the twenty-fifth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said William Littell Tizard, Her special licence that I, the said William Littell Tizard, my executors, administrators, and assigns, or such others as I, the said William Littell Tizard, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "Improvements in Heating, Cooling, and Condensing Apparatuses," upon the condition (amongst others) that I, the said William Littell Tizard, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

Tizard's Improvements in Heating, Cooling, and Condensing Apparatuses.

NOW KNOW YE, that I, the said William Littell Tizard, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, reference being had to the Drawings hereunto annexed, that is to say) :—

My Invention consists in casting, of any suitable metal or compound of metals, in one piece, a square or oblong cellular plate closed on three sides and open on its fourth side; two of its contiguous sides have flanges on both top and bottom, which project a little more than one half of the thickness of its two other sides which are without flanges. The interior of this cellular plate is provided with partitions parallel with each other, each of which is short at one end alternately, so as to prolong the current of such fluids as pass between them and around their short ends. These partitions by being cast on the top and bottom portions of the cellular plate also strengthen the casting, and enable it to withstand considerable internal pressure. A number of these castings of adequate area and proportionate to the power of the instrument required being provided, the flanges of each are planed and bolt holes drilled in them to correspond each with the other. These cellular plates are now piled one on the other, coming in contact by their flanges, only sufficient space being allowed between their thinner parts to admit the flat and thinnest part of a plate (being its flangeless parts) without either touching the other. This pile or nest of plates is bolted together on two sides. The edges of the open side of the nest (all the open sides being one over the other) are now planed to admit of being closed water or steam tight by a door. There are also communications from one cellular plate to another, and ingress and egress pipes by which steam, water, or other fluid passes from one corner of the lowest plate to one corner of the uppermost plate, traversing in its devious course around one end of each partition, and upwards by means of a short tubular connection with the next plate, and through its somewhat zig-zag course heating or cooling the two surfaces of each cellular plate throughout the whole series of the nest until the fluid makes its exit. The above being but one-half of the apparatus a similar nest of cellular plates is constructed, excepting that it is mounted on four grooved wheels, and its upper plate has its sides raised so as to form a shallow receptacle for the fluid to be cooled or heated. One of these nests is fixed in a shallow trough, on the bottom of which is a small tramway. The four grooved wheels before alluded to are placed on the lowest part of the other nest which runs on the tramway when it approaches or recedes from its counterpart, viz^{t}., the stationary nest first described. When these two nests of cellular plates are brought together they

intersect without touching each other either top or bottom, thus forming a shallow space or channel throughout their combined series of one-sixteenth of an inch or less in depth between each plate, but their sides necessarily touch to prevent the fluid that is being operated on running in a wrong direction.

Figure 1 of the accompanying Drawings is a partial section of the square or oblong casting open on one side constructed according to my Invention. *a*, *b*, are flanges at top and bottom of each plate for uniting together a series of plates *c*, *c*. Figure 2 is another vessel also fitted with plates *d*, *d*, similar to those marked *c*, *c*, which are placed one within the other with a set of partitions shown at Figure 3, all as represented at Figure 4. The plate c^1 on the partitions shewn at Figure 3 forms a door to the apparatus. The vessel shewn at Figure 2 carrying the plates *d*, *d*, is mounted on wheels *e*, *e*, whereby this vessel is run into that shewn at Figure 1. *f* is the inlet pipe for the wort or other liquid to be cooled, which takes a zig-zag course in its passage through the vessel, as indicated by the arrows, falls into a tray *g* at bottom, & finds its exit by the pipe *h*; *i* is the inlet pipe for the water to the vessel shown at Figure 1, and *k* is the inlet pipe for the water to the vessel shewn at Figure 2. The water in both cases circulates upwards through the vessels, as indicated by the arrows, and passes off by the pipes *l*, *l*.

When the apparatus above described is used for heating water the two nests are run into each other, or rather the moveable nest is run into the stationary one, and the water flows over the top plate, passing over its front edge and falls on the innermost surface of the second plate (which is the uppermost in the fixed chest) and under the bottom of the top plate, until it reaches the front of the second plate, when the water flows back (but still descending) between the bottom of the second plate and the surface of the third plate, and so on until it reaches the trough from which it is conveyed to its destination. During the time the water is flowing through this thin channel steam passes into the lowest cellular plates of both nests by separate pipes, winding its way through the passages formed by the internal partitions, and upwards through each plate until it makes its exit from a pipe in the top plate of each nest. By regulating the quantity of either steam or water the latter is heated to any temperature required while running through the apparatus.

When the above instrument is used for the purpose of cooling liquids, such as brewers' worts, for example, the hot wort is run on to the top plate and through the thin channel formed by the exterior of the combined nests of cellular plates; cold water flows upwards through their interior in the same devious path which the steam takes when heating a fluid.

Any instrument which is used for the above purposes requires cleaning

daily or immediately after using. To cleanse the exterior parts of this apparatus ample space is afforded by merely separating the two nests by rolling the one on the tramway out of its fixed counterpart. Their separation at once converts the channels that were before but $\frac{1}{16}$th of an inch deep into open spaces or gaps of about two inches in depth, each of which is open sufficiently on two sides to admit an ordinary scrubbing brush. The interior steam or cold water spaces are cleaned with equal facility on opening the doors which close them when in use.

The novel character of this arrangement of cellular plates consists in making the apparatus in two similar and separable parts, so that when they are asunder they may be readily cleaned, and when together a channel of unlimited thinness is formed for the passage of the fluids to be either heated or cooled.

In constructing steam condensers for marine and other purposes (such as distilling) upon the principle above described, the cellular plates have but one flange on each side, instead of two as before described, and are placed on their edges (upright) and side by side to facilitate their drainage or exhaustion, and are an inch or more apart when the two nests are together, so as to make room for a large quantity of condensing water. When the two nests are separated for the purpose of cleansing them they present spaces at least three inches deep (or wide, the plates being vertical), being ample for the introduction of scrapers or scrubbers of any strength or form, the steam condenses on the interior of each cellular plate. When preferred, the condensing water may be made to flow through the plates, and the steam to condense on their outsides; by this reversal, the power of the condenser is greater, and a more perfect vacuum ensured, owing to the very thin steam spaces which are afforded by this arrangement. The apparatus is enclosed in a suitable case, and supplied with the necessary ingress and egress pipes.

Another part of my Invention has for its object economy of heat and fuel on board such steam ships as are not provided with surface condensers and where the common jet system of condensation only is in use. Sea water contains a variable quantity of common salt besides a small quantity of salts of lime and magnesia. To allow these substances, particularly the two last, to accumulate in the boilers is to hasten their destruction by the formation of a hard insoluble scale, which obstructs the free passage of heat from the furnaces to the water. The thickness of the deposit is proportionate to the temperature of the water, the quantity of salts it holds in solution, and the frequency of "blowing off." To prevent their accumulation and adhesion to a dangerous extent, a much larger quantity of water is pumped into the boilers from the

hot well than is required for the formation of steam, and this additional water is blown out again into the sea with its surplus salts and acquired caloric. This process of feeding and blowing to be effective is continuous, and amounts upon an average to one half of the water fed into the boilers during a voyage. The heat thus blown away is generally equivalent to 20 per cent. of the coals consumed, and in waters of southern latitudes is considerably greater, notwithstanding that all the water used comes from the hot well at a temperature varying from 100° to 120° Fahrenheit. The temperature of the water thus blown away depends upon the pressure of the steam under which the engines are worked, which, if taken at 20 lbs. per inch, would be 261°. The foregoing conveys the necessary data, viz^{t}., that as much water at 261° is blown out of the boilers as is supplied to them at 110°. This part of my Invention is to cause the well water and the blown-out water to exchange their temperatures. I pass the waste water as it is ejected from the boilers through a cellular or tubular apparatus (which is here called a refrigerator) on one side of its plates or tubes (as the case may be) into the sea, and at the same time by pumping the well water in the opposite direction through the same apparatus on the other side of the plates or tubes into the boilers; thus, the well water enters the apparatus at 110° degrees, and goes into the boilers at 261°, while the waste water is cooled from 261° to 110° before it escapes to the sea.

The following arrangement not only utilizes a great portion of the heat heretofore lost by a wasteful system, but in addition thereto increases the purity of the water supplied to the boilers, and proportionately reduces the necessity of blowing off; the before-named refrigerator is mounted with a steam chest connected with the hot well by means of a pipe and cock. On partially blowing off the briny contents of a boiler, instead of conveying them directly through the refrigerator, as at first proposed, they are retained there a minute or two, or until the pressure in both boiler and refrigerator is the same when the latter is nearly full; about half a minute more is sufficient to allow the steam and water to separate and settle. The cock in the steam chest is now turned on, and the steam converted by condensation into fresh water by mixing with the contents of the hot well. Thus, the purity of the feed water is increased, as is also its temperature. The contents of the refrigerator are, by this evaporating process, reduced from 261 to 212° Fahrenheit. The well water is now pumped through the apparatus and in its transit to the boilers is heated to 212°. The waste or blow-off water is blown into the sea by the next charge, a few degrees hotter than that from which no steam was taken, in consequence of the feed water acquiring additional heat from the extra steam it condenses.

I cool atmospheric air, oxygen gas, or other aëriform bodies by pumping or

forcing them into a similar multitudular cylinder, as last described, or into the refrigerator before mentioned, until considerable heat is developed by such compression; I then abstract the caloric by passing cold water either through the small tubes of the cylinder or by running cold water on to the exterior of the refrigerator, until the atmospheric air or other compressed aëriform body is cooled down to the temperature of the water; I then discharge it into whatever vessel fluids or liquids may require oxydising or cooling, (or both,) below the temperature of ordinary spring water, which varies from 51 to 53 Fahr.

Another arrangement, form, and adaption of cast cellular plates is designed for cooling the surface of brewers' worts when they are undergoing the vinous fermentation, and also for collecting the yeast therefrom, so as to supersede the ordinary mode of cleansing, into a number of small casks. It consists in casting them of any suitable metal, such as copper, brass, or iron, and afterwards tinning or galvanizing them. They are of an oblong form with shallow trough-like tops, inverted cone-like bottoms, and closed ends, with one or more partitions running through their interior. Three or more are bolted together side by side, about an inch apart; it is through the spaces thus formed that the yeasty wort rises, and they are connected by means of tubes for the ingress and egress of water which runs through the series. The raised sides by which their trough-like surfaces are formed are also connected by short pipes, through which the yeasty contents of one trough flows into the other.

Figure 5 is a sectional elevation, and Figure 6 is a plan of the arrangement just described. *m*, *m*, are the shallow trough-like tops of the oblong vessels, and *n*, *n*, are the inverted cone-like bottoms of the same; *o*, *o*, are pipes forming a communication between the conical bottoms. Water is admitted by the pipe *p*, circulates through the cone-like bottoms until it issues by the pipe *q*. The trough-like tops *m*, *m*, contain the wort or other liquid to be cooled, and the beer contained in it runs off by the pipes *r*, *r*. The wort troughs may be put in communication with one another by pipes, if desired.

Improved means to regulate the cooling & separation of such clean beer as subsides on & under precipitated & floating yeast is also an additional improvement. The apparatus consists of a tube screwed on its exterior, which passes thro' one of the double troughs, working in a screwed nut & a stuffing box. On the upper end is a small cup or cistern with a few holes in its bottom, & a movable cover on its top. It is thro' the perforated bottom that all the beer passes that runs from the surface of the double troughs (or the series of barm backs) downwards into the square. By raising or lowering this separating apparatus so that its perforations shall be in the clean beer towards the close of the fermenting or cleansing process, the latter will flow away cool into the